

CLAIMS

1. A buffer meter for monitoring a data level of data in a buffer and for
2 outputting an arbitration level signal for prompting the data to be read
from the buffer, the buffer meter comprising:
 - 4 an actual count counter for monitoring the data level in the buffer,
the actual count counter having an actual count output;
 - 6 a minimum rate counter for generating a minimum count output,
the minimum count output for guaranteeing a minimum rate
8 of reading the data from the buffer;
 - a maximum rate counter for generating a maximum count output,
10 the maximum count output for limiting the data read from
the buffer to a maximum rate; and
 - 12 a level select means for determining a value of the arbitration level
signal based upon the actual count output, the minimum
count output and a flow control enable input.
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2. The buffer meter of claim 1, further comprising a maximum rate
2 generator for outputting a plurality of maximum rate enable pulses at the
maximum rate to the maximum rate counter, wherein the maximum count
4 output is incremented for each maximum rate enable pulse and
decremented for a read of the data buffer.
3. The buffer meter of claim 2, further comprising a free space output for
2 prompting a data server to send more data to the buffer, the free space
output calculated from the maximum count output less the actual count
4 output, the free space output having an upper limit of a data capacity of
the buffer.

4. The buffer meter of claim 3, wherein the maximum count output is
2 constrained to be greater than or equal to the actual count output.
5. The buffer meter of claim 1, wherein the maximum rate is a first user-
2 specified input.
6. The buffer meter of claim 1, further comprising a minimum rate
2 generator for outputting a plurality of minimum rate enable pulses at the
minimum rate to the minimum rate counter, wherein the minimum count
4 output is incremented for each minimum rate enable pulse and
decremented for a read of the data buffer.
7. The buffer meter of claim 1, wherein the minimum rate is a second
2 user-specified input.
8. The buffer meter of claim 6, wherein the minimum count output is
2 constrained to be less than or equal to the actual count output.
9. The buffer meter of claim 1, wherein the value of the arbitration level
2 signal is set to the actual count output when the flow control enable input
is disabled; wherein the value of the arbitration level signal is set to a data
4 packet size when the flow control enable input is enabled and the actual
count output is greater than or equal to the data packet size and the
6 minimum count output is less than the data packet size; and wherein the
value of the arbitration level signal is set to the minimum count output
8 when the flow control enable input is enabled and the actual count output
is greater than or equal to the data packet size and the minimum count
10 output is greater than or equal to the data packet size.

10. The buffer meter of claim 1, wherein the buffer meter is implemented
 2 in one of software, hardware, and a combination of software and
 hardware.

11. A method for controlling data flow from a buffer of a plurality of
 2 buffers connected to a multiplexer, the multiplexer reading the buffer
 based upon an arbitration level received from a buffer meter monitoring
 4 the buffer, the method comprising the steps of:
 setting a flow control input of the buffer meter to one of an enable
 6 state and a disable state;
 generating a minimum count for guaranteeing a minimum rate of
 8 reading data from the buffer;
 generating a maximum count for limiting the data read from the
 10 buffer;
 generating an actual count of data in the buffer; and
 12 generating the arbitration level based upon the actual count, the
 minimum count and the flow control input.

12. The method of claim 11, wherein the step of generating the
 2 arbitration level further comprises the steps of:
 setting the arbitration level to the actual count if the flow control
 4 input is set to the disable state;
 setting the arbitration level to a data packet size if the flow control
 6 input is set to the enable state and the actual count is greater
 than or equal to the data packet size and the minimum count
 8 is less than the data packet size; and
 setting the arbitration level to the minimum count if the flow
 10 control input is set to the enable state and the actual count
 output is greater than or equal to the data packet size and
 12 the minimum count output is greater than or equal to the

data packet size.

13. The method of claim 11 wherein the step of generating the minimum count further comprises the steps of:

generating a plurality of minimum rate pulses based upon the minimum rate;
incrementing the minimum count for each minimum rate pulse if minimum count is less than the actual count;
decrementing the minimum count for each read of the buffer if minimum count is greater than a value of zero; and
setting the minimum count to the actual count if minimum count is greater than or equal to the actual count.

14. The method of claim 11 wherein the step of generating the maximum count further comprises the steps of:

generating a plurality of maximum rate pulses based upon a desired maximum rate;
decrementing the maximum count for each read of the buffer if maximum count is greater than the actual count;
incrementing the maximum count for each maximum rate pulse if the maximum count is less than a size of the buffer; and
setting the maximum count to the actual count if the maximum count is less than the actual count.

15. A multiplexer system for implementing a plurality of quality of service guarantees for the transmission of data from a plurality of data channels, the multiplexer system comprising:

the plurality of data channels for outputting packets of data, each data channel comprising:
an input means for accepting and requesting data from a

data server;

8 a buffer for holding the accepted data;

a smart meter for generating an arbitration level, the smart

10 meter comprising:

a flow control enable input;

12 an actual count output of a data level in the buffer;

a reported free space output connected to the input

14 means, wherein the input means requests data

from the data server to fill the buffer based

16 upon the reported free space output;

a minimum count output for guaranteeing a minimum

18 rate of reading data from the buffer; and

a level select means for determining a value of the

20 arbitration level based upon the actual count

output, the minimum count output and the flow

22 control enable input;

an arbitration logic means for selecting a data channel of said

24 plurality of data channels based upon the arbitration level;

and

26 a multiplexer controlled by the arbitration logic means, the

multiplexer selecting and transmitting data from the buffer of

28 the selected data channel.

16. The multiplexer system of claim 15, wherein the smart meter is

2 implemented in one of software, hardware, and a combination of software

and hardware.

17. The multiplexer system of claim 15, wherein the plurality of quality

2 of service guarantees comprises a fixed opportunistic data rate insertion

guarantee, a maximum data rate insertion limit, a minimum data rate

- 4 insertion guarantee, and a minimum null rate insertion guarantee.

18. The multiplexer system of claim 17, wherein the minimum count
 2 output is generated from a user-specified minimum rate input, the user-
 specified minimum rate input for implementing the minimum data rate
 4 insertion guarantee.

19. The multiplexer system of claim 15, further comprising:
 2 a virtual null buffer for outputting null data packets; and
 a virtual null meter connected to the arbitration logic means, the
 4 virtual null meter for generating a null buffer arbitration level;
 wherein the null buffer arbitration level provides a minimum null
 6 rate insertion guarantee of null data packets from the virtual
 null buffer.

20. The multiplexer system of claim 15, wherein the reported free space
 2 output is generated based upon a user-specified maximum rate input and
 the actual count output, the user-specified maximum rate input utilized for
 4 implementing the maximum data rate insertion limit.